

=  $4.69X^{0.74}$ ,  $r = 0.90$ ,  $Y$ , force;  $X$ , body weight), they are not suitable for testing this relationship, because bufonids are weak jumpers and our sample is dominated by strong jumpers. We do, however, wish to correct the typographical error in Gans' and Rosenberg's derivation, because  $F^2M^{-2} \sim M^{1/3}$  becomes  $F^2 \sim M^{7/6}$  or  $F \sim M^{7/12}$  and not  $F \sim M^{7/6}$ .

#### Acknowledgments

We wish to thank Drs. S. Emerson, C. Gans, W. R. Heyer, and J. Mosimann for their comments on the manuscript.

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## *New World Opiinae (Hymenoptera: Braconidae)* *Parasitic on Tephritidae (Diptera)*

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#### ABSTRACT

A key is presented for the New World species of Opiinae that have been recorded as parasites of Tephritidae, including species introduced and established in the New World. A brief discussion is given for each species including distribution, hosts, biological references, and distinguishing characteristics. One new species is described, *Biosteres sublaevis*, n. sp., and the following new synonymies are indicated: *Biosteres tryoni* (= *Parasteres acidusae*), *Doryctobracon* (= *Parachasma*), *D. crawfordi* (= *D. conjugens*), *Opius anastrepha* (= *O. argentina* and *O. mombinpraeoptantis*), *O. bellus* (= *O. gomesi* and *O. turicai*), *O. canaliculatus* (= *O. lectus* and *O. lectoides*), and *O. frequens* (= *O. glasgowi*).

A large number of opiine braconids has been described from the New World. Although nothing is known concerning the biology of the majority of these, 39 species have been reared from various

members of the dipterous family Tephritidae. This paper is an aid to the identification of these species and brings some of the literature pertaining to them together in one place. A key is presented to 39 species followed by a brief discussion of each species including distribution, host records, biological references, and distinguishing characteristics. Tobias (1977) has discussed the European species of *Opius* parasitic on fruit flies.

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We have included here only those species for which there is reliable information concerning their hosts, either from the literature or from labels on specimens in the National Insect Collection in Washington. We have discussed briefly a few species that have been introduced but not established in the New World but these are not included in the key. A few synonymies will affect names of parasites, some of which are being actively studied at the present: *Parasteres* Fischer is returned to *Biosteres* Foerster and *P. acidusae* Fischer is synonymized with *B. tryoni* (Cameron); *Parachasma* Fischer is synonymized with *Doryctobracon* Enderlein; *D. areolatus* (Szépligeti) replaces *Parachasma cereum* (Gahan); *D. conjugens* Enderlein is synonymized with *D. crawfordi* (Viereck); *Bracanastrepha argentina* Brèthes and *Opius mombinpraeoptantis* Fischer are synonymized with *O. anastrephae* Viereck; *O. gomesi* Costa Lima and *O. turicai* Blanchard are synonymized with *O. bellus* Gahan; *O. lectus* Gahan and *O. lectoides* Gahan are synonymized with *O. canaliculatus* Gahan; and *O. glasgowi* Fischer is synonymized with *O. frequens* Fischer. One new species is described from Texas.

The tephritid hosts and their Opiinae parasites are summarized in the list that follows.

*Anastrepha* sp.

- Doryctobracon capsicola* (Muesebeck)
- Doryctobracon tucumanus* (Turica & Mallo)
- Opius hirtus* Fischer
- Anastrepha benjamini* Costa Lima
- Doryctobracon areolatus* (Szépligeti)
- Anastrepha consobrina* (Loew)
- Doryctobracon areolatus* (Szépligeti)
- Anastrepha fraterculus* (Wiedemann)
- Doryctobracon areolatus* (Szépligeti)
- Doryctobracon brasiliensis* (Szépligeti)
- Doryctobracon fluminensis* (Costa Lima)
- Doryctobracon zeteki* (Muesebeck)
- Opius anastrephae* Viereck

- Opius bellus* Gahan
- Anastrepha interrupta* Stone
- Doryctobracon anastrephilus* (Marsh)
- Anastrepha ludens* (Loew)
- Doryctobracon areolatus* (Szépligeti)
- Doryctobracon crawfordi* (Viereck)
- Anastrepha montei* Costa Lima
- Doryctobracon areolatus* (Szépligeti)
- Opius bellus* Gahan
- Anastrepha obliqua* (Macquart)
- Biosteres tryoni* (Cameron)
- Doryctobracon areolatus* (Szépligeti)
- Opius anastrephae* Viereck
- Opius bellus* Gahan
- Anastrepha pickeli* Costa Lima
- Doryctobracon areolatus* (Szépligeti)
- Anastrepha rheediae* Stone
- Opius vierecki* Gahan
- Anastrepha serpentina* (Wiedemann)
- Doryctobracon areolatus* (Szépligeti)
- Doryctobracon auripennis* (Muesebeck)
- Doryctobracon trinidadensis* (Gahan)
- Opius bellus* Gahan
- Anastrepha striata* Schiner
- Doryctobracon crawfordi* (Viereck)
- Doryctobracon trinidadensis* (Gahan)
- Doryctobracon zeteki* (Muesebeck)
- Opius vierecki* Gahan
- Anastrepha suspensa* (Loew)
- Biosteres longicaudatus* Ashmead
- Doryctobracon anastrephilus* (Marsh)
- Opius anastrephae* Viereck
- Opius concolor* Szépligeti
- Ceratitis capitata* (Wiedemann)
- Biosteres longicaudatus* Ashmead
- Biosteres oophilus* (Fullaway)
- Biosteres tryoni* (Cameron)
- Opius bellus* Gahan
- Dacus ciliatus* Loew\*
- Biosteres longicaudatus* Ashmead
- Dacus cucurbitae* Coquillett\*\*
- Biosteres longicaudatus* Ashmead
- Dacus curvipennis* (Froggatt)\*\*
- Biosteres longicaudatus* Ashmead
- Dacus dorsalis* Hendel\*\*\*
- Biosteres longicaudatus* Ashmead
- Biosteres tryoni* (Cameron)
- Dacus frauenfeldi* Schiner\*
- Biosteres longicaudatus* Ashmead
- Dacus incisus* Walker\*
- Biosteres longicaudatus* Ashmead



- Dacus latifrons* (Hendel)\*  
*Biosteres longicaudatus* Ashmead  
*Dacus limbifer* (Bezzi)\*  
*Biosteres longicaudatus* Ashmead  
*Dacus nubilus* Hendel\*  
*Biosteres longicaudatus* Ashmead  
*Dacus passiflorae* (Froggatt)\*  
*Biosteres tryoni* (Cameron)  
*Dacus pedestris* (Bezzi)\*  
*Biosteres longicaudatus* Ashmead  
*Dacus psidii* (Froggatt)\*  
*Biosteres longicaudatus* Ashmead  
*Dacus tryoni* (Froggatt)\*  
*Biosteres longicaudatus* Ashmead  
*Biosteres tryoni* (Cameron)  
*Dacus xanthodes* (Broun)\*  
*Biosteres tryoni* (Cameron)  
*Dacus zonatus* (Saunders)\*  
*Biosteres longicaudatus* Ashmead  
*Eutreta xanthochaeta* Aldrich  
*Biosteres tryoni* (Cameron)  
*Gerrhoceras* sp.  
*Opius tafivallensis* Fischer  
*Myoleja limata* (Coquillett)  
*Biosteres melleus* (Gahan)  
*Opius aciurae* Fischer  
*Procecidochares utilis* Stone  
*Biosteres longicaudatus* Ashmead  
*Biosteres tryoni* (Cameron)  
*Rhagoletis basiola* (Osten Sacken)  
*Opius baldufi* Muesebeck  
*Opius rosicola* Muesebeck  
*Rhagoletis berberis* Curran  
*Opius downesi* Gahan  
*Rhagoletis boycei* Cresson  
*Biosteres juglandis* (Muesebeck)  
*Rhagoletis cingulata* (Loew)  
*Biosteres melleus* (Gahan)  
*Diachasma ferrugineum* (Gahan)  
*Opius frequens* Fischer  
*Rhagoletis indifferens* Curran  
*Diachasma muliebre* (Muesebeck)  
*Opius rosicola* Muesebeck  
*Rhagoletis completa* Cresson  
*Biosteres sublaevis* Wharton  
*Biosteres tryoni* (Cameron)  
*Rhagoletis cornivora* Bush  
*Opius canaliculatus* Gahan  
*Rhagoletis fausta* (Osten Sacken)  
*Diachasma ferrugineum* (Gahan)  
*Opius canaliculatus* Gahan  
*Opius frequens* Fischer
- Rhagoletis juglandis* Cresson  
*Biosteres juglandis* (Muesebeck)  
*Rhagoletis mendax* Curran  
*Biosteres melleus* (Gahan)  
*Opius canaliculatus* Gahan  
*Rhagoletis pomonella* (Walsh)  
*Biosteres melleus* (Gahan)  
*Diachasma alloenum* (Muesebeck)  
*Diachasma ferrugineum* (Gahan)  
*Opius canaliculatus* Gahan  
*Opius downesi* Gahan  
*Opius richmondi* Gahan  
*Rhagoletis suavis* (Loew)  
*Biosteres melleus* Gahan  
*Rhagoletis tabellaria* (Fitch)  
*Opius canaliculatus* Gahan  
*Opius downesi* Gahan  
*Opius juniperi* Fischer  
*Opius tabellariae* Fischer  
*Rhagoletis zephyria* Snow  
*Opius canaliculatus* Gahan  
*Tomoplagia* sp.  
*Opius itatiayensis* Costa Lima  
*Tomoplagia rudolphi* (Lutz & Costa Lima)  
*Opius tomoplagiae* Costa Lima  
*Toxotrypana curvicauda* Gerstäcker  
*Doryctobracon toxotrypanae* (Muesebeck)  
*Zonosemata electa* (Say)  
*Biosteres sanguineus* (Ashmead)  
*Zonosemata vittigera* (Coquillett)  
*Biosteres sanguineus* (Ashmead)

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\* Not known to occur in the New World.

\*\* Trapped in California on a few occasions, but extensive surveys showed no subsequent infestations.

\*\*\* Established in California on several separate occasions but successfully eradicated each time.

The key to species that follows is aimed at the non-specialist in braconid taxonomy, for whom some terms may be unfamiliar. Some of these terms are defined below.

*Malar space.* The space between the eye and base of mandible.

*Mesonotal midpit.* A pit on the mesonotum just in front of the prescutellar furrow (see below), sometimes represented only by a small circular shallow

pit, other times by an extended tear-drop-shaped depression.

*Notauli.* Two furrows on the mesonotum extending posteriorly from the anterior lateral corners and meeting at the prescutellar furrow. They are usually smooth but sometimes have cross carinae at regular intervals appearing to be a row of pits, in which case they are termed crenulate. They are synonymous with parapsidal furrows of older descriptions.

*Occipital carina.* A carina or ridge that goes around the back of the head separating the occiput from the temples and vertex.

*Prescutellar furrow.* A transverse furrow in front of the scutellum separating it from the mesonotal lobes; usually with

distinct cross carinae dividing it into sections.

*Propodeum.* The last segment of the thorax, actually the morphological first abdominal segment fused with the thorax.

*Sternaulus.* A groove on the lower part of the mesopleuron extending from the middle coxa forward usually to the middle of the pleuron. It can be either smooth or crenulate (see notauli for definition of crenulate).

*Wing venation.* See Fig. 1 for explanation of terms.

As is the case with most braconids, males not associated with females are difficult to identify. Therefore, the key that follows is based mainly on the females.

#### Key to the New World Opiinae Reared from Tephritidae

1. Second radial segment of fore wing longer than first intercubitus (fig. 1, R1, I1); postnervellus of hind wing (see fig. 5, Pn) usually absent or only weakly indicated ..... 2
- Second radial segment equal to or shorter than first intercubitus (fig. 5); postnervellus present, often strongly pigmented ..... 19
- 2(1). Second abdominal tergite always and base of third often distinctly striate; lower border of mandible notched ..... 3
- Abdomen unsculptured beyond first tergite; lower border of mandible evenly curved ..... 4
- 3(2). Ovipositor about as long as first abdominal tergite; first tergite usually rugulose or granular ..... *Opius baldufi* Muesebeck
- Ovipositor at least as long as abdomen beyond first tergite; first tergite usually striate ..... *Opius downesi* Gahan
- 4(2). Recurrent vein of fore wing entering first cubital cell (fig. 6) ..... 5
- Recurrent vein entering second cubital cell (as in fig. 5), very rarely interstitial with intercubitus (as in figs. 1, 4) ..... 8
- 5(4). Propodeum with well developed longitudinal median carina; third segment of discoidal vein of fore wing (D3) absent or nearly so (fig. 2, 3) ..... 6
- Propodeum without carinae; third segment of discoidal vein present and well developed (fig. 6) ..... *Opius tafivallensis* Fischer
- 6(5). Stigma of fore wing nearly linear (fig. 3), about 9 times longer than wide ..... *Opius hirtus* Fischer
- Stigma broad (fig. 2), roughly 4 times longer than wide ..... 7
- 7(6). Opening present between mandibles and clypeus when mandibles closed; stigma yellow ..... *Opius concolor* Szépligeti
- Opening absent between mandibles and clypeus when mandibles closed; stigma brown ..... *Opius bellus* Gahan
- 8(4). Occipital carina absent ..... 9
- Occipital carina present and well developed ..... 13
- 9(8). Mesonotal midpit absent ..... *Opius bucki* Costa Lima
- Mesonotal midpit present and nearly always deep ..... 10
- 10(9). Eye small, at most 2.5 times longer than malar space; width of clypeus less than 2.5 times height (figs. 14, 16) ..... 11
- Eye larger, usually at least 3 times longer than malar space; width of clypeus more than 2.75 times height ..... 12



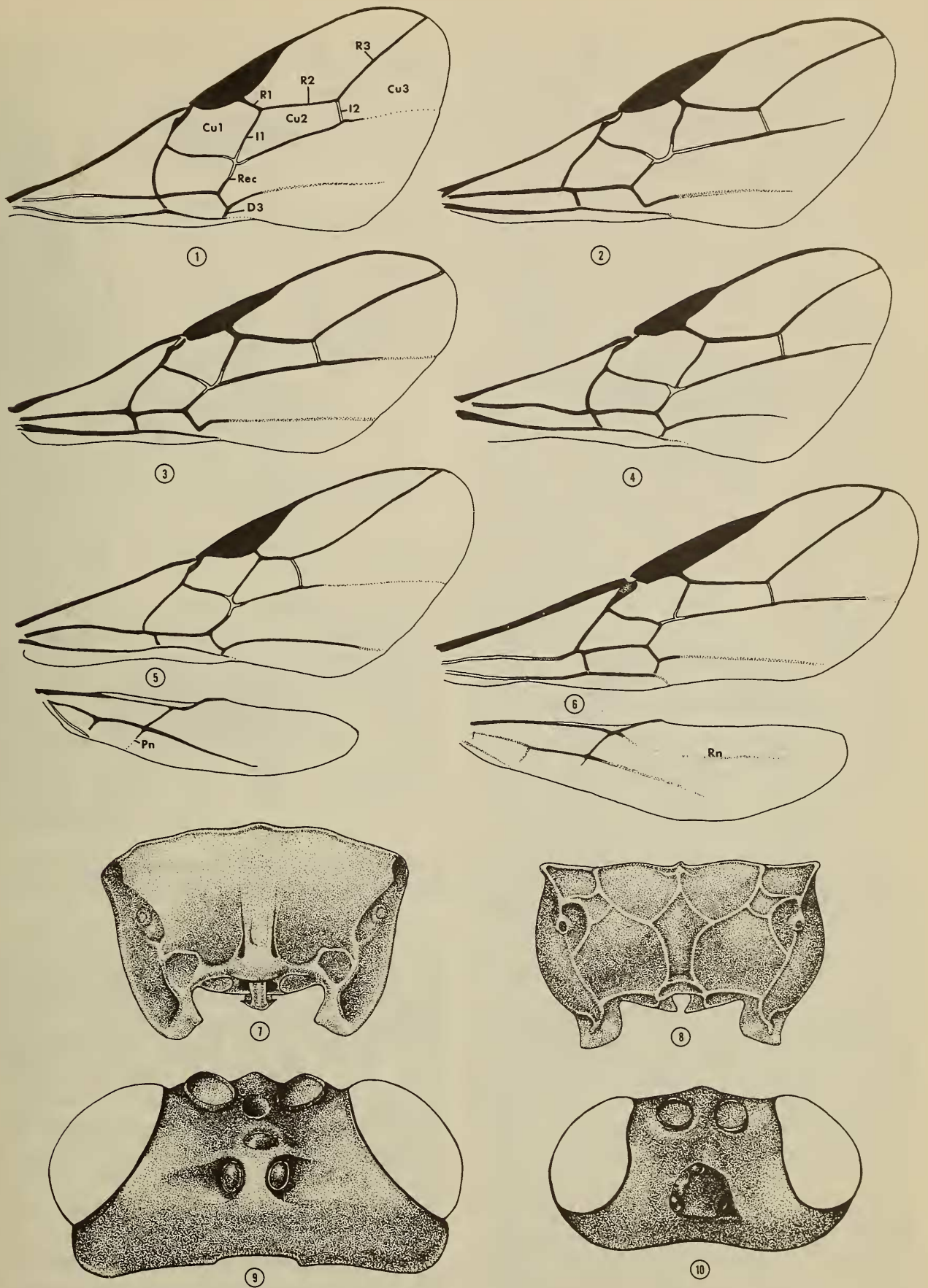
11(10).	Propodeum distinctly areolate; facial carina present between antennae but weak .....	<i>Opius tomoplagiae</i> Costa Lima	
	Propodeum with only a pair of short carinae at apex; facial carina strong, nearly spinose, between antennae .....	<i>Opius itatiayensis</i> Costa Lima	
12(10).	Eyes large, strongly bulging in dorsal view (fig. 9), more than 4 times longer than temples .....	<i>Opius vierecki</i> Gahan	
	Eyes moderately sized, not strongly bulging in dorsal view (fig. 10), less than 3.5 times longer than temples .....	<i>Opius anastrephae</i> (Viereck)	
13(8).	Ovipositor extending beyond apex of abdomen by distance equal to or shorter than first abdominal tergite .....		14
	Ovipositor extending beyond apex of abdomen by distance greater than first tergite .....		16
14(13).	Carinae on first abdominal tergite weak or absent; propodeum weakly rugose medially; temples as seen from above bulging slightly beyond margin of eye .....	<i>Opius juniperi</i> Fischer	
	Carinae on first tergite strong; propodeum strongly rugose; temples sloping inward, not bulging beyond eye margin .....		15
15(14).	Mesopleuron always marked with black, propodeum usually black or dark brown .....	<i>Opius canaliculatus</i> Gahan	
	Mesopleuron honey yellow, propodeum usually honey brown .....	<i>Opius acicuriae</i> Fischer	
16(13).	Dark colored species, most of thorax and abdomen dark brown or black ..		17
	Light colored species, body entirely orange, rarely propodeum brown ...		18
17(16).	Prescutellar furrow divided into two distinct pits by strong central carina; second radial segment of fore wing not more than 3 times longer than second intercubitus; abdominal tergites 2 and 3 usually black .....	<i>Opius frequens</i> Fischer	
	Prescutellar furrow not divided into two pits, all carinae of equal size; second radial segment about 4 times longer than second intercubitus; tergites 2 and 3 yellow .....	<i>Opius tabellariae</i> Fischer	
18(16).	Ovipositor not longer than one-half abdomen; body length 4-5 mm .....	<i>Opius rosicola</i> Muesebeck	
	Ovipositor about as long as abdomen; body length 2-3 mm .....	<i>Opius richmondi</i> Gahan	
19(1).	Opening present between mandibles and clypeus when mandibles closed; apical margin of clypeus concave, truncate, or sinuous (figs. 11, 13) ...		20
	Opening absent between mandibles and clypeus when mandibles closed; apical margin of clypeus convex (fig. 12) .....		33
20(19).	Apical margin of clypeus sinuous (fig. 13); recurrent vein entering first cubital cell, sometimes nearly interstitial with intercubitus; occipital carina absent .....		21
	Apical margin of clypeus concave to truncate (fig. 11); recurrent vein entering second cubital cell; occipital carina well developed, at least at lower edges .....		31
21(20).	Propodeum areolate (fig. 8); head of most species yellow or orange, sometimes black dorsally but at least lower face yellow .....		22
	Propodeum bearing only a pair of short apical carinae (fig. 7), never areolate; head dark brown to black .....		28
22(21).	Fore wings yellow with black apical border .....		23
	Fore wings predominately concolorous, hyaline to infuscated .....		24
23(22).	Head and hind femur largely black; first abdominal tergite roughly 1.2 (♀) and 1.5 (♂) times longer than apical width ...	<i>Doryctobracon zeteki</i> (Muesebeck)	
	Head and hind femur yellow or yellow orange; first tergite 1.0 (♀) and 1.2 (♂) times longer than apical width .....	<i>Doryctobracon auripennis</i> (Muesebeck)	
24(22).	Fore and middle tibiae and femora dark brown to black, at least in part ...		25
	Fore and middle tibiae and femora yellow or yellow orange .....		26
25(24).	Ovipositor slightly but distinctly shorter than body; stigma without black border .....	<i>Doryctobracon anastrephilus</i> (Marsh)	

- Ovipositor slightly but distinctly longer than body; stigma with black border ..... *Doryctobracon tucumanus* (Turica & Mallo)
- 26(24). Wings hyaline or nearly so; posterior femur yellow .....  
 ..... *Doryctobracon areolatus* (Szépligeti)
- Wings infuscated except for a small light patch beyond stigma; posterior femur dark, at least in part ..... 27
- 27(26). Apical abdominal tergites of female yellow .....  
 ..... *Doryctobracon capsicola* (Muesebeck)
- Apical abdominal tergites of female dark .....  
 ..... *Doryctobracon fluminensis* (Costa Lima)
- 28(21). Stigma yellow ..... *Doryctobracon brasiliensis* (Szépligeti)
- Stigma brown ..... 29
- 29(28). Head and thorax black, abdomen yellow; clypeus strongly sinuous .....  
 ..... *Doryctobracon toxotrypanae* (Muesebeck)
- Head often dark brown, thorax and abdomen orange; clypeus usually not as strongly sinuous ..... 30
- 30(29). Frons with dense area of hair directly behind antennae .....  
 ..... *Doryctobracon crawfordi* (Viereck)
- Frons smooth and hairless behind antennae .....  
 ..... *Doryctobracon trinidadensis* (Gahan)
- 31(20). First abdominal tergite smooth apically, median pair of carinae absent posteriorly ..... *Diachasma muliebre* (Muesebeck)
- First tergite rugose apically, median pair of carinae strong throughout .... 32
- 32(31). Antennae usually 38–42 segmented; ovipositor subequal to length of body ...  
 ..... *Diachasma ferrugineum* (Gahan)
- Antennae usually 43–47 segmented; ovipositor much longer than body ...  
 ..... *Diachasma alloeum* (Muesebeck)
- 33(19). Second abdominal tergite heavily striate ..... 34
- Second abdominal tergite smooth, or nearly so ..... 37
- 34(33). Notauli distinct and deeply impressed throughout their length ..... 35
- Notauli absent posteriorly, not reaching mesonotal midpit ..... 36
- 35(34). Thorax and abdomen dark brown; notauli crenulate .....  
 ..... *Biosteres oophilus* (Fullaway)
- Thorax and abdomen orange; notauli smooth .....  
 ..... *Biosteres longicaudatus* Ashmead
- 36(34). Second cubital cell of fore wing large, third radial segment less than 3.5 times length of second segment ..... *Biosteres melleus* (Gahan)
- Second cubital cell small; third radial segment more than 4.2 times longer than second segment (fig. 5) ..... *Biosteres sublaevis* Wharton, n. sp.
- 37(33). Wing hyaline; hind femur yellow to yellow orange .....  
 ..... *Biosteres juglandis* (Muesebeck)
- Wing membrane distinctly infuscated; hind femur dark brown ..... 38
- 38(37). Abdominal tergites largely dark brown to black; ovipositor about 1.5 times longer than thorax plus abdomen; fore and middle femora yellow .....  
 ..... *Biosteres tryoni* (Cameron)
- Abdominal tergites orange; ovipositor subequal to length of thorax plus abdomen; fore and middle femora dark brown .....  
 ..... *Biosteres sanguineus* (Ashmead)

In the discussion below, the distribution, hosts, and most significant literature references are given for each species. Many distribution records and literature references pertaining to areas outside the New World have been omitted for some of the introduced species, but they can be found in Fischer (1971).

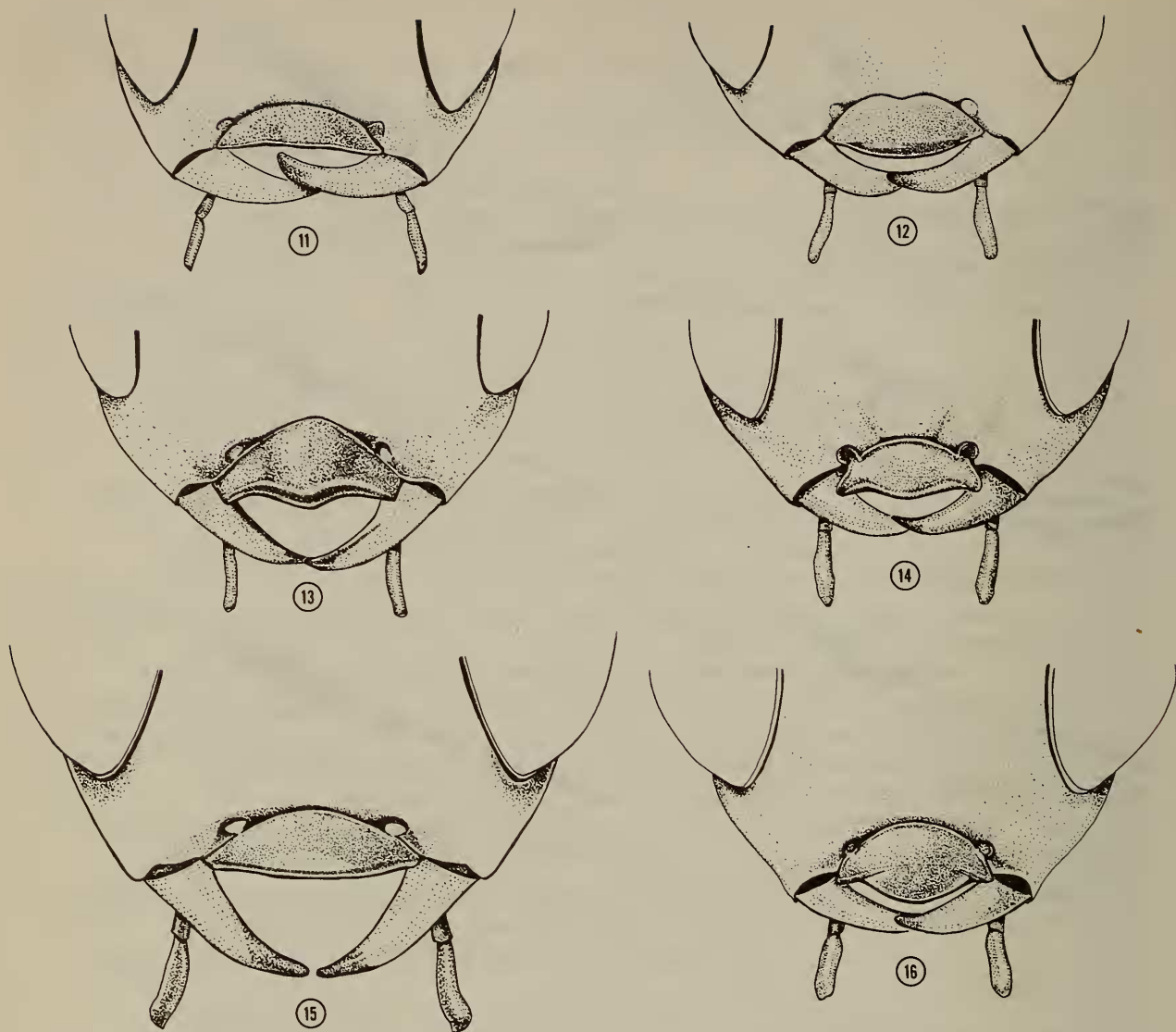
#### Genus *Biosteres* Foerster

- Biosteres* Foerster, 1862:259.  
*Zetetes* Foerster, 1862:258.  
*Chilotrichia* Foerster, 1862:258.  
*Stenospilus* Foerster, 1862:259.  
*Rhandospilus* Foerster, 1862:259.  
*Opiellus* Ashmead, 1900:368.  
*Celiestella* Cameron, 1903:343.  
*Diachasmimorpha* Viereck 1913:641.



Figs. 1-6. Wings: 1, *Opius rosicola* Muesebeck; 2, *O. bellus* Gahan; 3, *O. hirtus* Fischer; 4, *O. anastrephae* (Viereck); 5, *Biosteres sublaevis* Wharton, n. sp.; 6, *O. tafivallensis* Fischer. Figs. 7-8. Propodeum: 7, *Doryctobracon trinidadensis* (Gahan); 8, *D. anastrephilum* (Marsh). Figs. 9-10. Head, dorsal view: 9, *O. vierecki* Gahan; 10, *O. anastrephae*. Abbreviations: Cu1, Cu2, Cu3 = 1st, 2nd, and 3rd cubital cells; D3 = 3rd segment of discoideus; I1, I2 = 1st and 2nd intercubiti; Pn = postnervellus; R1, R2, R3 = 1st, 2nd, and 3rd segments of radius; Rec = recurrent vein; Rn = radiellen vein.





Figs. 11–16. Lower portion of face, anterior view: 11, *Diachasma muliebri* (Muesebeck); 12, *Biosteres melleus* (Gahan); 13, *Doryctobracon anastrephilum* (Marsh); 14, *Opius itatiayensis* Costa Lima; 15, *O. vierecki* Gahan; 16, *O. tomoplagiae* Costa Lima.

*Biosteres* (*Parasteres*) Fischer, 1967:3. New synonymy.

Fischer (1967) originally described *Parasteres* as a subgenus of *Biosteres* and later (Fischer 1971) gave it full generic status. Still later (Fischer 1973) separated it from *Biosteres* by placing *Parasteres* in a different tribe, the Desmiostomatini, which he characterized as having the occipital carina completely absent. This seems to be an unnatural arrangement, however, as the occipital carina is variously reduced in both *Biosteres* and *Opius* of the tribe Opiini. The relative development of the occipital carina appears to be an attribute of species or possibly subgenera rather than a generic

or tribal characteristic. And in at least one species, the development of such a carina is intraspecifically variable. Variables involving the shape of the mandibles and clypeus and the presence, absence, and relative lengths of various wing veins, are much more significant and useful for discriminating higher categories. And even these characters are insufficient in themselves and are best used in combination for the accurate characterization of genera in the Opiinae. Fischer's Opiini and Desmiostomatini need to be reassessed to determine the true cross-tribal relationships of the included genera. Tobias (1977) has rejected the generic separation of *Biosteres*,

*Diachasma*, and *Opius*, retaining them as subgenera of *Opius*. We have seen the male holotype of the type-species of *Parasteres*, and it agrees well with the genus *Biosteres*. Further it is conspecific with *B. tryoni*.

The genus *Biosteres* is characterized as follows: second cubital cell short, second radial segment usually shorter than first intercubitus; post-nervellus well developed; clypeus large, opening between clypeus and mandibles absent when mandibles closed.

*Biosteres juglandis* (Muesebeck)

*Opius juglandis* Muesebeck, 1961:57.

*Distribution*.—Arizona, New Mexico; laboratory reared in California.

*Hosts*.—*Rhagoletis boycei*, *R. juglandis*.

*Biosteres juglandis* differs from its close relatives in the *longicaudatus* complex by the absence of well-developed sculpture on the second abdominal tergite. Some sculpture is discernible on a few specimens but this is always limited to the base of the tergite. The biology of this species has recently been studied by Buckingham (1975).

*Biosteres longicaudatus* Ashmead

*Biosteres longicaudatus* Ashmead, 1905:970.

*Distribution*.—First described from the Philippines; also collected in Costa Rica and Mexico. Released and successfully established in Hawaii and recently in southern Florida (Baranowski 1974) and Trinidad (Bennett *et al.* 1977).

*Hosts*.—*Anastrepha suspensa*, *Ceratitis capitata*, *Dacus ciliatus* (?), *D. cucurbitae*, *D. curvipennis*, *D. dorsalis*, *D. frauenfeldi*, *D. incisus*, *D. latifrons*, *D. limbifer*, *D. nubilus*, *D. pedestris*, *D. psidii*, *D. tryoni*, *D. zonatus*, *Procecidochares utilis*.

*Additional references*.—Ashley *et al.* 1977(1976) (adult emergence); Beardsley 1961 (status of varieties and forms); Fullaway 1951, 1953 (discussion and description of new varieties); Greany,

Allen *et al.* 1977 (laboratory rearing); Greany, Ashley *et al.* 1976 (detailed life history and rearing techniques from laboratory cultures in Florida); Greany, Tumlinson *et al.* 1977 (host finding); Lawrence *et al.*, 1976 (effect of host age on development); Lawrence *et al.* 1978 (oviposition behavior); van den Bosch *et al.* 1951 (one of numerous status reports following introduction into Hawaii).

A large amount of additional literature is available concerning the introduction, mass rearing, and use of *longicaudatus* for biological control of fruit flies in Hawaii and other regions of the World.

*Biosteres longicaudatus* is similar to both *melleus* and *sublaevis*. Populations of *longicaudatus* introduced into the New World differ from these two species in the possession of distinctly lighter basal flagellomeres. It should be noted, however, that some of the described varieties of *longicaudatus* do have a completely dark flagellum. In addition to characters mentioned in the key, specimens of *longicaudatus* often have a dark apical or subapical band on the abdomen, and the posterior ocelli are more widely spaced than in *melleus* and *sublaevis*. Another distinguishing character for *longicaudatus* is the distinctive kink near the tip of the ovipositor.

The status of the numerous varieties belonging to the *longicaudatus* complex needs to be examined in much more detail. The mass rearing and introduction of large numbers of these varieties into the same habitats has undoubtedly altered some of the physiological (and perhaps morphological) barriers which may still persist in the Oriental Region.

*Biosteres melleus* (Gahan)

*Opius melleus* Gahan, 1915:73

*Biosteres rhagoletis* Richmond, 1915:294.

*Distribution*.—Minnesota and Nova Scotia south to Florida.

*Hosts*.—*Rhagoletis cingulata*, *R. mendax*, *R. pomonella*, *R. suavis*, *Myoleja limata*? (numerous specimens from Florida have been reared from *Ilex* spp.,



and *M. limata* is the only tephritid known from this host plant (Wasbauer 1972)).

*Additional references.*—Lathrop and Nickels 1932; Lathrop and Newton 1933 (detailed biology on the blueberry maggot, includes essential details of all earlier reports).

This species is most closely related to *sublaevis* n. sp. It differs primarily in the configuration of the second cubital cell. In addition, the sternaulus is strongly crenulate in *melleus* but nearly smooth in *sublaevis*. Specimens of *melleus* from Florida, although reared from a different host and unrelated host plant, appear essentially identical to those reared from *Rhagoletis mendax* and *R. pomonella* in Maine. There are some slight differences in the shape of the second cubital cell. Because of the unusual host, some doubt must be attached to the Florida material until further biological information can be obtained. *Biosteres melleus* differs from the species of *Opius* attacking *R. pomonella*, *R. mendax*, and *R. cingulata* by lacking an opening between the clypeus and mandibles, the strigose tergite two, and the shorter second radial segment.

*Biosteres oophilus* (Fullaway)

*Opius oophilus* Fullaway, 1951:248

This Oriental species has been reared in the laboratory in Costa Rica on *Ceratitis capitata* and is included here in the event that it becomes established. It can be distinguished from all New World species on tephritids by the crenulate notauli.

*Biosteres sanguineus* (Ashmead)

*Phaerotoma* (?) *sanguineus* Ashmead, 1889(1888): 655.

*Distribution.*—Maryland to Florida and west to Missouri and Arizona

*Hosts.*—*Zonosemata electa*, *Z. vittigera*.

*Additional references.*—Ashmead 1892 (brief note on host association with the weed *Solanum carolinense*); Cazier 1962 (brief note on biology).

This species is characterized by the dark wings, dark legs, and completely orange body in both sexes. In addition, it has a shorter ovipositor and a much more robust appearance than other species of *Biosteres*. Other than the brief notes by Ashmead and Cazier, nothing is known about the biology of *sanguineus*.

*Biosteres sublaevis* Wharton, new species<sup>2</sup>  
(Fig. 5)

*Head.*—1.67–1.80 (M = 1.74, H = 1.76)<sup>3</sup> times broader than long, 1.20–1.34 (M = 1.24, H = 1.21) times broader than mesonotum; eyes slightly bulging beyond temples in dorsal view, eyes roughly twice as long as temples. Temples, occiput and frons (laterally) moderately densely hairy; eyes bare. Occipital carina strong to mid eye height; face distinctly hair-punctured, slightly protruding medially, usually with weak median carina above middle. Face nearly twice wider than high; clypeus roughly three times wider than high. Lower border of clypeus evenly convex; opening almost completely absent between clypeus and mandibles when mandibles closed. Mandible roughly 1.8 times broader at base than at apex, upper and lower borders gradually diverging at apex, more strongly diverging over basal third; upper tooth larger, extending distinctly distad of lower. Malar space  $\frac{1}{3}$  to  $\frac{1}{4}$  eye height, roughly 0.7 times basal width of mandible. Distance between antennal bases about equal to distance between antennae and eyes; antenna roughly 1.5 times longer than body, 41–45 segmented. Maxillary palps distinctly longer than head.

*Thorax.*—1.24–1.36 (M = 1.30, H = 1.26) times longer than high; 1.32–1.41 (M = 1.34, H = 1.32) times higher than wide. Mesonotum strongly declivous anteriorly; densely hairy and weakly punctured throughout, hairs longer, more erect, and less dense posteriorly and on scutellum; notauli very deep, but short, very weakly impressed to absent beyond anterior-lateral corners; mesonotal midpit deep, tear-drop shaped. Prescutellar groove 3 to 4 times broader than long, with well-developed midridge and distinct lateral ridges of varying strength. Apical half of propodeum strongly declivous; propodeum rugulose, sparsely hairy throughout; median areola occasionally discernible. Metapleuron and mesopleural disc sparsely hairy centrally; hairs on mesopleuron shorter and more numerous than on metapleuron. Sternaulus distinctly impressed, but nearly unsculptured. Hind femur nearly 3.5 times longer than mid-width.

*Wings* (fig. 5).—stigma broad, discrete, 2.65–3.30 (M = 3.06, H = 2.67) times longer than broad; first

<sup>2</sup> The description of this new species is to be credited solely to R. A. Wharton.

<sup>3</sup> M = median, H = holotype.



segment of radius short, arising from near middle of stigma,  $\frac{1}{3}$  to  $\frac{1}{5}$  length of second segment, third segment 4.20–5.50 (M = 4.96, H = 4.21) times longer than second segment and ending before wing tip; first intercubitus 1.32–1.73 (M = 1.46, H = 1.52) times longer than second segment of radius, roughly 1.65 times longer than second intercubitus; recurrent vein postfurcal by  $\frac{1}{3}$  to  $\frac{2}{9}$  its own length, 0.51–0.59 (M = 0.56, H = 0.51) times length of first segment of discoideus; nervellus postfurcal by about its own length; subdiscoideus arising from well below middle of closed brachial cell; first mediellan segment roughly 1.3 times longer than second; postnervellus long, nearly reaching wing margin, weakly sclerotized posteriorly.

*Abdomen.*—petiole 1.10–1.25 (M = 1.16, H = 1.13) times longer than apical width; apex nearly twice wider than base; surface striate and bicarinate, the carinae often weak and indistinguishable beyond middle, especially in smaller specimens. Tergite 2 densely striate medially, smooth laterally; gaster smooth beyond tergite 2. Ovipositor sheath densely hairy, with at least 5 rows of moderately long hairs; ovipositor more than twice length of thorax.

*Color.*—orange; ovipositor sheaths, mandibular teeth, flagellum, pedicel, and scape (dorsally) dark brown; hind tibiae dorsally and most of hind tarsi often lighter brown; wings hyaline, veins dark brown.

*Length.*—2.2–3.5 mm.

*Holotype.*—female; Texas, Jefferson Davis County, Davis Mountains, August 1974, ex. *Rhagoletis completa*, S. Berlocher. Deposited in USNM.

*Paratypes.*—7 ♀♀, 3 ♂♂, same data as holotype. Deposited in USNM and personal collection of K. Hagen, University of California, Berkeley.

This species is closely related to *melleus*, particularly the Florida populations of that species (see discussion above), but differs primarily in the possession of a distinctly shorter second radial segment. In addition, the sternaulus is much more deeply impressed and sculptured in *melleus* than in *sublaevis*. *B. sublaevis* is also similar to *B. giffardii* (Silvestri) and *B. carinatus* Szépligetii but differs in having more extensive abdominal sculpture and a broader stigma. It differs from *longicaudatus* primarily in having much weaker notauli. One of the specimens from the type locality appears to be deformed. The striations on tergite 2 are very weak although still extending to the apex of the segment.

The specimens of the type-series were made available by Dr. K. Hagen, University of California, Berkeley, who originally suggested that they might represent a new species.

#### *Biosteres tryoni* (Cameron)

*Opius tryoni* Cameron 1911:343.

*Biosteres* (*Parasteres*) *acidusae* Fischer, 1967:3.  
New Synonymy.

*Distribution.*—Originally described from Australia; introduced into California (Boyce 1934), Puerto Rico (Bartlett 1941), and Hawaii (Pemberton and Willard 1918b); not recovered in California.

*Hosts.*—*Anastrepha obliqua*, *Ceratitis capitata*, *Dacus dorsalis*, *D. passiflorae*, *D. tryoni*, *D. xanthodes*, *Eutreta xanthochaeta*, *Procecidochares utilis*, *Rhagoletis completa*.

*Additional references.*—Pemberton and Willard 1918a (competition with *Opius humilis*); Pemberton and Willard 1918b (life history as *Diachasma tryoni*); Bartlett 1941 (rearing, release, recovery, and then apparent loss in Puerto Rico). Further information on this species can be found in the numerous accounts of the rearing, release, and status of fruit fly parasites for attempts at biological control especially in Hawaii.

This species is characterized by the poorly developed to absent occipital carina. It is similar to the Australian *deeralensis* in this regard but is otherwise unrelated due to strong differences in the shape of the clypeus. The clypeus is weakly indented as seen from below in *tryoni*, similar to *longicaudatus*, but *tryoni* is easily separated from the other *Biosteres* species included here by the color pattern of darkened wings and dark abdomen in both sexes.

*B. acidusae* was described from a single male taken in Puerto Rico by K. A. Bartlett (Fischer, 1967). It agrees in all respects with other Puerto Rican material collected by Bartlett in the same year and from the same host following the introduction and establishment of *tryoni*.

#### Genus *Diachasma* Foerster

*Diachasma* Foerster, 1862:259.

*Bathystomus* Foerster, 1862:235.

*Atoreuteus* Foerster, 1862:241.

Like *Biosteres* and *Doryctobracon*, *Diachasma* is characterized by the short second cubital cell and the presence of a postnervellus in the hind wing. *Diachasma* differs from *Biosteres* by

the presence of a broad opening between the clypeus and mandibles, and from *Doryctobracon* by the shorter more evenly margined clypeus and the well-developed occipital carina.

*Diachasma alloenum* (Muesebeck)

*Opius alloeus* Muesebeck, 1956:101.

*Distribution.*—Ontario to New Brunswick; Connecticut, Florida, Maine, New York, Pennsylvania.

*Host.*—*Rhagoletis pomonella*.

*Additional references.*—Boush and Baerwald 1967 (courtship behavior, evidence for a sex pheromone); Cameron and Morrison 1977 (mortality factor of *R. pomonella*); Rivard 1967 (distribution and rearing records).

This species has been bred from *R. pomonella* in all of the above areas. As Muesebeck (1956) has noted, this species is closely related to *ferrugineum*, but *alloenum* has a distinctly longer ovipositor and is a somewhat larger species. The metapleuron is also usually more heavily sculptured.

*Diachasma ferrugineum* (Gahan)

*Opius ferrugineus* Gahan, 1915:75.

*Distribution.*—Northeastern United States and eastern Canada; Florida, California (?).

*Hosts.*—*Rhagoletis cingulata*, *R. fausta*, *R. pomonella*.

*Additional references.*—Harper 1962, 1963 (release, recovery, and successful establishment in California); Fleschner 1963 (record of release in California against *R. cingulata*); Porter 1928 (discussion of reasons for low percentage of parasitism on *P. pomonella*). Other references listed in Fischer (1971) are limited to rearing records. Apparently *ferrugineum* attacks *R. pomonella* only rarely.

Harper (1962) and Fleschner (1963) indicate that *ferrugineum* was released in California and Harper (1963) stated that it was recovered, but we have not seen any specimens from California to substantiate that fact. Parasites recovered

from release sites of *ferrugineum* in California are apparently all *muliebri*.

Muesebeck (1956) separated *muliebri* from eastern *ferrugineum* on the basis of a minor, but apparently constant difference in sculpture of the first abdominal tergite, that of *muliebri* being smooth apically. The two species also have differing biologies, *muliebri* being parthenogenetic and *ferrugineum* being bisexual. Further biological studies are needed to determine if the two species are indeed distinct.

*Diachasma muliebri* (Muesebeck)  
(Fig. 11)

*Opius muliebri* Muesebeck, 1956:100.

*Distribution.*—Washington to California.

*Host.*—*Rhagoletis indifferens*.

See the discussion under *ferrugineum* for relationships of *muliebri* and *ferrugineum*.

Genus *Doryctobracon* Enderlein

*Doryctobracon* Enderlein, 1920(1918):144.

*Parachasma* Fischer, 1967:7.

Fischer (1967) proposed the name *Parachasma* for this distinctive group but apparently overlooked Enderlein's *Doryctobracon* since it was not originally placed in the Opiinae. Fischer (1973) later recognized *Doryctobracon* in a generic key implying, but not directly stating, that *Parachasma* was a synonym. The synonymy and new combinations were later published in Fischer (1977).

Members of this genus are probably all parasites of Tephritidae. Species are quite closely related and separated primarily by color differences (Fischer 1964b, 1965b, 1967) but need to be more carefully examined with respect to biology and intraspecific variations to determine their exact identities.

*Doryctobracon* is characterized by the distinctive shape of the clypeus (fig. 13), the short second cubital cell, strong post-nervellus, recurrent vein entering first cubital cell, and the absence of an occipital carina.



*Doryctobracon anastrephilus* (Marsh)  
(Figs. 8, 13)

*Parachasma anastrephilum* Marsh, 1970:31.

*Distribution.* — Southern Florida.

*Host.* — *Anastrepha interrupta*, *A. suspensa*.

This species is characterized by the complete propodeal areola, dark legs, and relatively short ovipositor. Nothing is known about its biology other than the host rearing listed.

*Doryctobracon areolatus* (Szépligeti),  
new combination

*Biosteres areolatus* Szépligeti, 1911:286.

*Opius cereus* Gahan, 1919:169. **New synonymy.**

*Opius saopaulensis* Fischer, 1961:290. **New synonymy.** Unnecessary new name for *areolatus* Szépligeti 1911.

*Distribution.* — Argentina, Brazil, Mexico, Panama, Trinidad, Venezuela; Florida, recently introduced and established.

*Hosts.* — *Anastrepha benjamini*, *A. consobrina*, *A. fraterculus*, *A. ludens*, *A. montei*, *A. obliqua*, *A. pickeli*, *A. serpentina*.

*Additional references.* — Baranowski and Swanson 1970, 1971 (release and recovery in Florida, as *cereum*); Clausen, Clancy, and Clock 1965 (unsuccessful attempts against Hawaiian fruit flies due to specificity on *Anastrepha*, as *cereum*); Plummer, McPhail, and Monk 1941 (host records, as *cereum*).

The type of *areolatus* agrees very well with specimens of *cereus* from Brazil; the clypeus is slightly less sinuate, but we feel they are definitely the same species. Fischer (1967) places this species in *Diachasma*. The clypeus on the type is not very sinuate, but there is no occipital carina and the recurrent vein is antefurcal, placing *areolatus* in *Doryctobracon*.

Little information has been published on the biology of this species despite the numerous introductions (as *Doryctobracon cereus*). It is readily distinguished by the relative hyalinity of the wings and appears to be quite close to *anastrephilus*, but the legs are predominately yellow rather than black.

*Doryctobracon auripennis* (Muesebeck)

*Opius auripennis* Muesebeck, 1958:453.

*Distribution.* — Panama.

*Host.* — *Anastrepha serpentina*.

This species is quite similar to *zeteki* but differs in having both head and hind femora yellow or yellow orange instead of predominately dark brown to black. The only biological information is the host record above.

*Doryctobracon brasiliensis* (Szépligeti)

*Biosteres brasiliensis* Szépligeti, 1911:285.

*Coeloides anastrephae* Brèthes, 1924:7.

*Opius (Diachasma) brasilianus* Fischer, 1963:392. Unnecessary new name for *brasiliensis* Szépligeti 1911.

*Distribution.* — Argentina, Brazil.

*Host.* — *Anastrepha fraterculus*.

*Additional references.* — Costa Lima 1937 (host and distributional records).

The only biological information available for *brasiliensis* is the host record listed. This species is easily distinguished by the brightly colored stigma of the fore wing. The few individuals available for study indicate that the body is usually dark but variable in color.

Costa Lima (1937) synonymized *anastrephae* with *Biosteres brasiliensis* Szépligeti 1902. This should be 1911, since Szépligeti described *Opius brasiliensis* in 1902 which is definitely not the same as *Biosteres brasiliensis*. We have seen the types of *Biosteres brasiliensis* and *Coeloides anastrephae*, and they are definitely the same species.

*Doryctobracon capsicola* (Muesebeck)

*Opius capsicola* Muesebeck, 1958:450.

*Distribution.* — Panama.

*Host.* — *Anastrepha* sp. in *Manihot esculenta* seed capsules.

The only biological information is that listed above taken from the specimen labels. This species is nearly identical with *fluminensis*, but the vertex is darker and the apical abdominal tergites lighter in the female of *capsicola*. These two species differ from other *Doryctobracon*



with a complete propodeal areola by the color of the legs and fore wings.

*Doryctobracon crawfordi* (Viereck)

*Diachasma crawfordi* Viereck, 1911:181.

*Doryctobracon conjugens* Enderlein, 1920(1918):  
144. New synonymy.

*Distribution.*—Central America, Colombia, Ecuador.

*Hosts.*—*Anastrepha ludens*, *A. striata*.

*Additional references.*—Baker *et al.* 1944 (summary and interpretations of previous biological accounts); Crawford 1927 (host records); Darby 1933, Darby and Kapp 1934 (importance of temperature and humidity in development compared to *A. ludens*); Keilin and Picado 1913 (description of larvae and adults, as species of *Diachasma*); Keilin and Picado 1920 (rearing techniques); McPhail and Bliss (parasitism on *A. ludens*); Plummer, McPhail, and Monk 1941 (host records). Several other workers have discussed the unsuccessful attempts to introduce this species into other areas.

We have seen the type of *conjugens* and it is identical with that of *crawfordi*. This species is characterized by reduced propodeal sculpture, uniformly dark wings, and orange body. It is similar to *trinidadensis* in coloration but has a more extensively punctate and densely hairy frons.

*Doryctobracon fluminensis* (Costa Lima)

*Opius fluminensis* Costa Lima, 1938:69.

*Distribution.*—Brazil, Venezuela.

*Host.*—*Anastrepha fraterculus*.

This species is very similar to *capsicola* but the apical abdominal segments are darker and the vertex lighter in the females of *fluminensis*. The only biological information known is the host record listed.

*Doryctobracon toxotrypanae* (Muesebeck)

*Opius toxotrypanae* Muesebeck, 1958:451.

*Distribution.*—Costa Rica, Mexico.

*Host.*—*Toxotrypana curvicauda*.

No additional information is available concerning this species. It is very similar to *crawfordi* but has a darker

thorax. The extent of the dark markings on the thorax is sometimes variable, and the two species, which are sympatric over part of their ranges, are best separated by their host preferences.

*Doryctobracon trinidadensis* (Gahan)  
(Fig. 7)

*Opius trinidadensis* Gahan, 1919:168.

*Distribution.*—Trinidad.

*Hosts.*—*Anastrepha serpentina*, *A. striata*.

There is no information about this species other than the rearing records mentioned by Gahan (1919). It is very similar to *crawfordi* but is distinguished by smooth and hairless frons behind the antennae.

*Doryctobracon tucumanus* (Turica and Mallo),  
new combination

*Opius tucumanus* Turica and Mallo, 1961:149.

*Distribution.*—Argentina.

*Host.*—*Anastrepha* sp. on "ubajay."

*Additional references.*—Blanchard 1966 (redescription, as new species, listed as common in Loreto); Hayward 1941, 1943 (rearing and releases in Tucuman against unnamed fruit flies).

Almost nothing has been published on the biology of this species. It is similar in coloration and propodeal sculpture to *anastrephilus* but has a distinctly longer ovipositor.

*Doryctobracon zeteki* (Muesebeck)

*Opius zeteki* Muesebeck, 1958:454.

*Distribution.*—Panama.

*Hosts.*—*Anastrepha fraterculus*, *A. striata*.

The only biological information known about *zeteki* is the host records mentioned. This species is similar to *auripennis* but has a darker head and darker femora.

Genus *Opius* Wesmael

*Opius* Wesmael, 1835:115.

At least 21 synonyms are associated with *Opius*, and we are not listing them here. The complete list of synonyms can be found in Fischer 1971.

Most of the New World *Opius* species reared from tephritids have the post-nervellus of the hind wing lacking or weakly developed. Otherwise, the genus contains a number of distinct morphological groups. The differences between these groups appear to be as great as those separating some of the other genera discussed above. In fact, Fischer (1973, 1977) has resurrected *Bracanaastrepha* Brèthes for those species lacking an occipital carina and having an opening between the clypeus and mandibles. This genus, whose type-species is the same as *Opius anastrephae* Viereck (see below), has not been further characterized or discussed, however, and it seems premature to split off some of the species discussed below before the genus *Opius* has been adequately studied as a whole and the relationships of the various included groups are sufficiently understood.

The members of Fischer's *truncatus*-group subgroup II (Fischer 1964:271) appear to form a distinct morphological unit and all are probably parasites of the Tephritidae. Most are separable only with difficulty and even then only on the basis of slight differences in color and ovipositor length. Unassociated males are extremely difficult to identify. Some of the species are undoubtedly synonyms, but more work is needed on intraspecific variation and host preferences before such synonymies can be resolved. Differences in biology and internal anatomy may eventually prove of more importance than color and ovipositor length in separating these species.

*Opius aciurae* Fischer

*Opius aciurae* Fischer, 1964a:272.

*Distribution.*—Florida.

*Host.*—*Myoleja limata* on *Ilex* spp.

Almost nothing is known concerning this species. It is nearly identical to *canaliculatus* except for the lighter coloration. The difference in host range appears sufficient in itself to separate the two species.

*Opius anastrephae* Viereck  
(Figs. 4, 10)

*Opius anastrephae* Viereck, 1913:563.

*Bracanaastrepha argentina* Brèthes, 1924:8. New synonymy.

*Opius mombinpraeoptantis* Fischer, 1966:116. New synonymy.

*Distribution.*—Argentina, Brazil, Central America, West Indies; Florida.

*Hosts.*—*Anastrepha fraterculus*, *A. obliqua*, *A. suspensa*.

*Additional references.*—Clausen, Clancy, and Chock 1965 (introduction attempts, host records, limitations in biological control); Gowdy 1925, Plank 1938, 1939, Bartlett 1941 (host records and rates of parasitism).

We have compared the types of *argentina* and *mombinpraeoptantis* with that of *anastrephae* and they are identical, apparently representing a color variable species. It can be distinguished by the absence of an occipital carina, large eyes, short malar space, and temples not bulging. This species was introduced into Hawaii and apparently into the continental U. S. but not established. The Florida record indicated above is based on specimens in the National Collection reared at Key Biscayne from *A. suspensa*.

*Opius baldufi* Muesebeck

*Opius baldufi* Muesebeck, 1949:256.

*Distribution.*—Illinois, Michigan, Minnesota, Wisconsin.

*Host.*—*Rhagoletis basiola* (Muesebeck's original description states host as *R. alternata*, which is a misidentification of *basiola*).

*Additional references.*—Balduf 1958 (effect of parasites on host size), 1959 (detailed life history).

This species belongs to the morphologically distinct *ochrogaster* group (Fischer 1964a:350) which differ from other species discussed here by the shape of the mandibles which bear a distinct notch on their lower edge. *O. baldufi* is similar to *downesi* but has a somewhat shorter ovipositor.



*Opius bellus* Gahan

(Fig. 2)

*Opius bellus* Gahan, 1930:1.

*Opius gomesi* Costa Lima, 1938:71. New synonymy.

*Opius turicai* Blanchard, 1966:24. New synonymy.

*Distribution.*—Argentina, Belize, Brazil, Costa Rica, Panama, Trinidad, Venezuela.

*Hosts.*—*Anastrepha fraterculus*, *A. montei*, *A. obliqua*, *A. serpentina*, *Ceratitis capitata*.

*Additional references.*—Bartlett 1941 (record of laboratory rearing in Puerto Rico and unsuccessful establishment); Costa Lima 1937, 1938 (host records); Guagliumi 1963 (host records).

Despite a widespread distribution, very little seems to have been published concerning this species. It is characterized by the antefurcal recurrent vein, broad stigma, complete absence of notauli, absence or near absence of sternaulus, and absence of the third discoidal segment of the fore wing.

Both *gomesi* and *turicai* were described as being quite close to *bellus* but differing in the color of the mesonotum. Gahan, in his original description of *bellus*, mentioned the color variation in this species, but this fact was apparently overlooked in the description of *gomesi* and *turicai* as new species. We have not been able to see the types of *gomesi* and *turicai* and the synonymy is based on the original descriptions.

*Opius bucki* Costa Lima

*Opius bucki* Costa Lima, 1938:71.

*Distribution.*—Brazil.

*Host.*—Unknown species of Tephritidae.

Nothing is known concerning this species other than the reference by Costa Lima. This species is characterized by the absence of both an occipital carina and a mesonotal midpit and by the presence of a postfurcal recurrent vein and a broad stigma. It does not appear to be similar to any of the other species treated here. The lower face appears unusually elongate because the eyes are fairly small.

*Opius canaliculatus* Gahan

*Opius canaliculatus* Gahan, 1915:80.

*Opius lectus* Gahan, 1919:167. New synonymy.

*Opius lectoides* Gahan, 1930:2. New synonymy.

*Distribution.*—Quebec south to Maryland, west to Oregon; Florida.

*Hosts.*—*Rhagoletis cornivora*, *R. fausta*, *R. mendax*, *R. pomonella*, *R. tabellariae*, *R. zephyria*.

*Additional references.*—Cameron and Morrison 1977 (mortality factor of *R. pomonella*); Middlekauff 1941 (rearing records); Rivard 1967 (rearing and emergence records). All references are to *lectus*.

We have been unable to adequately distinguish between *canaliculatus*, *lectus*, and *lectoides* on morphological grounds. Foote and Blanc (1963) have discussed the relationships between the two main host species of *Rhagoletis*, *pomonella* and *zephyria*, but there does not seem to be any differences in the parasites. We have seen four specimens from Florida reared from *R. cornivora* and they also are identical to *canaliculatus*.

This species is very similar to *acicurrae* and differs primarily in its darker coloration and host range.

*Opius concolor* Szépligeti

*Opius concolor* Szépligeti, 1910:244.

*Opius fuscitarsus* Szépligeti, 1913:605.

*Opius perproximus* Silvestri, 1914:103.

*Opius siculus* Monastero, 1931:195.

This Mediterranean species is being studied in Florida and has been successfully reared for several generations on *Anastrepha suspensa* (Baranowski, pers. comm.). It is included here in the likely event that it will be established. It is similar to *bellus* but is distinguished by its yellow stigma and the opening between clypeus and mandibles when the mandibles are closed.

*Opius downesi* Gahan

*Opius downesi* Gahan, 1919:164.

*Opius (Opius) berberidis* Fischer, 1964a:358.

*Distribution.*—British Columbia, Michigan, New Brunswick, New York, Ontario, Washington. Probably widely



distributed across northern U. S. and southern Canada.

*Hosts.*—*Rhagoletis berberis*, *R. pomonella*, *R. tabellaria*.

Almost nothing is known concerning this species. Downes (1919) mentioned it as a parasite of *R. pomonella*; the other records are based on reared specimens in the National Collection. This species is characterized by the unusual mandible and wing venation as in *baldufi* but differs from *baldufi* in the possession of a slightly longer ovipositor.

*Opius frequens* Fischer

*Opius (Opius) frequens* Fischer, 1964a:279.

*Opius (Opius) glasgowi* Fischer, 1964a:286. New synonymy.

*Distribution.*—Maine west to Washington and Oregon.

*Hosts.*—*Rhagoletis cingulata*, *R. fausta*.

Aside from rearing records based on label information, nothing appears to be known about this species.

*O. glasgowi* is based on a male specimen which differs from typical female *frequens* specimens only in its slightly lighter coloration. A female from the same series as the male type of *glasgowi*, found in the National Collection, is identical to specimens from the type series of *frequens* in both coloration and sculpture. This species is characterized and separated from other members of the nearctic *truncatus*-group as follows: dark body, weakly infuscated wings, and moderately long ovipositor. It most closely resembles the slightly lighter colored *tabellariae* but is distinguished by the length of the second intercubitus and the strong central carina in the prescutellar furrow.

*Opius hirtus* Fischer  
(Fig. 3)

*Opius (Opius) hirtus* Fischer, 1963:376.

*Distribution.*—Costa Rica, Dominican Republic.

*Host.*—*Anastrepha* sp.

The host record above is from label information on a single specimen reared

from guava in Costa Rica. This species is readily recognized by the narrowly elongate stigma, antefurcal recurrent vein, lack of an opening between clypeus and mandibles, unsculptured mesonotum, and weak radiellian vein of hind wing. It is perhaps closest to *tafvallensis*, but the later is black and white and *hirtus* is orange.

*Opius itatiayensis* Costa Lima  
(Fig. 14)

*Opius itatiayensis* Costa Lima, 1937:24 (in key); 1938:70 (description).

*Distribution.*—Brazil.

*Host.*—Tephritidae, possibly *Tomoplagia* (Costa Lima, 1937:23).

The only biological information on *itatiayensis* is the brief note by Costa Lima mentioned above. This species is separated from the other *Opius* species lacking an occipital carina by the relatively small eyes, postfurcal recurrent vein, and moderately sized clypeus. It is similar to *tomoplagiae* but has a strong facial carina and a more weakly sculptured propodeum.

*Opius juniperi* Fischer

*Opius (Opius) juniperi* Fischer, 1964a:288.

*Distribution.*—Arizona.

*Host.*—Possibly *Rhagoletis tabellaria*

The holotype and one paratype were reared from juniper berries in association with the above tephritid. Fischer also listed a specimen from Manitoba, but, since we have not seen this specimen and the wide range of localities seems too great, we have not included this record in the distribution. This species is separated from other Nearctic members of the *truncatus*-group by the near absence of sculpture on the petiole, the greatly reduced sculpture of the propodeum, and the bulging eyes.

*Opius richmondi* Gahan

*Opius richmondi* Gahan, 1919:165.

*Distribution.*—Maine, Minnesota.

*Host.*—*Rhagoletis pomonella*.

*Additional references.*—Lathrop and Nickels 1932 (rearing record).

Very little is known concerning this species. It is readily distinguished from other nearctic members of the *truncatus*-group by the much longer ovipositor, the petiolar carinae which usually extend to the apex as well-developed ridges, and the orange body.

*Opius rosicola* Muesebeck  
(Fig. 1)

*Opius rosicola* Muesebeck, 1949:254.

*Distribution.*—California, Illinois, Minnesota, Oregon, Saskatchewan, Washington, Wisconsin.

*Hosts.*—*Rhagoletis basiola*, *R. in-differens*.

*Additional references.*—Balduf 1958 (effect of parasite on host size), 1959 (detailed life history).

The material from western U. S. was reared from the cherry fruit fly in *Prunus emarginatus* but appears to be identical to the type material reared from rose hips. The biology of this species is apparently identical to that of *baldufi* despite strong morphological differences.

*O. rosicola* is similar to the other nearctic members of the *truncatus*-group with moderately long ovipositor but differs in the lighter coloration, the nearly hyaline wings, and the weak carinae on the petiole.

*Opius tabellariae* Fischer

*Opius (Opius) tabellariae* Fischer, 1964a:305.

*Distribution.*—Minnesota, New York.

*Host.*—*Rhagoletis tabellaria*.

The only biological information known is the host record listed above. This species is similar to *frequens* but differs in its shorter second intercubital vein and the prescutellar furrow not having a strong central dividing carina.

*Opius tafivallensis* Fischer  
(Fig. 6)

*Opius tafivallensis* Fischer, 1968:69.

*Distribution.*—Argentina, Peru.

*Host.*—*Gerrhoceras* sp.

The above host record is from labels on three specimens collected in San Mateo, Peru. This species is quite different from all other opiines discussed here because

of its black and white color. In addition, it has the petiole and propodeum unsculptured with the mesonotum and mesopleuron nearly so, the petiole narrowly elongate, the propodeum densely covered with long hairs, the postnervellus and third discoidal segments well-developed, the recurrent vein entering first cubital cell, and the stigma narrow.

*Opius tomoplagiae* Costa Lima  
(Fig. 16)

*Opius tomoplagiae* Costa Lima, 1937:24 (in key); 1938:69 (description).

*Distribution.*—Brazil.

*Host.*—*Tomoplagia rudolphi*.

This distinctive species is similar to *itatiayensis* but differs by its distinctly areolated propodeum and weak facial carina. The only biological information is the host record mentioned by Costa Lima (1937).

*Opius vierecki* Gahan  
(Figs. 9, 15)

*Opius vierecki* Gahan, 1915:76.

*Distribution.*—Mexico, Panama.

*Hosts.*—*Anastrepha rheediae*, *A. striata*.

Viereck stated in the original description that the type was "probably" reared from *A. striata*. The National Collection contains a specimen reared from *A. rheediae*. This species belongs to the neotropical complex of *Anastrepha* parasites which lack an occipital carina. It differs from other members of this group in having greatly enlarged eyes.

#### Other Species Not Included in Key

*Biosteres fullawayi* (Silvestri): Introduced into Puerto Rico but apparently not established.

*Opius fletcheri* Silvestri: Introduced into Puerto Rico but not established.

*Opius humilis* Silvestri: Introduced into California and Puerto Rico but apparently not established.

*Opius macrocerus* Thompson: Occurs in Europe, Japan, and is recorded from Michigan; a parasite of Agromyzidae but Fischer (1964c:9) lists it also as attacking *Trypeta* sp. which needs to be confirmed; apparently not related to any



species discussed in the present paper and the tephritid host is suspect.

#### Acknowledgments

Several institutions have aided this study by loaning types in their possession: Museo Argentino de Ciencias Naturales, Buenos Aires (Brèthes types); Hungarian Natural History Museum, Budapest (Szépligeti types); Polish Academy of Sciences, Warsaw (Enderlein types). The illustrations were made by Ellen Paige, to whom we are grateful. Use of the scanning electron microscope was supported in part by the Electron Microscope Central Facility, University of Maryland, College Park. Many helpful suggestions and comments were made by R. M. Baranowski, University of Florida, Homestead; F. D. Bennett, CIBC, Trinidad; and R. H. Foote, Systematic Entomology Laboratory, USDA.

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